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Response of Average Electron Velocity Vector under AC Electric and DC Magnetic Fields in a Constant-Collision-Frequency Model[1] HIROTAKE SUGAWARA, Hokkaido University, Japan — In order to study fundamental features of electron transport in magnetized plasmas, the average electron velocity $\mathbf{V}$ in gas under uniform AC electric and DC magnetic fields, $\mathbf{E}$ and $\mathbf{B}$, crossed at a right angle is theoretically derived assuming a constant collision frequency ν. When $\mathbf{E} = (0, -E\sin\omega_E t, 0)$ and $\mathbf{B} = (0, 0, B)$, the analytical solution of $\mathbf{V} = (V_x, V_y, V_z)$ in periodical steady state is $V_x = [2a\nu\omega_E\omega_B/\Omega]\cos\omega_E t + [a\omega_B(\omega_E^2 - \omega_B^2 - \nu^2)/\Omega]\sin\omega_E t$, $V_y = [a\nu(\omega_E^2 + \omega_B^2 + \nu^2)/\Omega]\sin\omega_E t - [a\omega_E(\omega_E^2 - \omega_B^2 + \nu^2)/\Omega]\cos\omega_E t$ and $V_z = 0$. Here, $a = eE/m$, $\omega_B = eB/m$, $\Omega = [(\omega_E + \omega_B)^2 + \nu^2][(\omega_E - \omega_B)^2 + \nu^2]$, and e and m are the electronic charge and mass. Although this model ignores the dependence of the collisions on electron energy, it is a merit that basic $\mathbf{V}$ responses at various E and B are predictable from the solution. $\mathbf{V}$ draws an ellipse in the V_xV_y-plane synchronously to $\mathbf{E}$ and the tilt of its major axis represents the time-averaged Hall deflection angle of $\mathbf{V}$. This depiction is informative to understand the electron swarm response under AC $\mathbf{E}$ and DC $\mathbf{B}$ fields.

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Hirotake Sugawara
Hokkaido University

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